



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/062,687	01/30/2002	Hiroyuki Okuyama	113278-005	2178
29175	7590	09/20/2004	EXAMINER	
BELL, BOYD & LLOYD, LLC P. O. BOX 1135 CHICAGO, IL 60690-1135			DOLAN, JENNIFER M	
			ART UNIT	PAPER NUMBER
			2813	

DATE MAILED: 09/20/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/062,687

Applicant(s)

OKUYAMA ET AL.

Examiner

Jennifer M. Dolan

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 June 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-82 is/are pending in the application.
- 4a) Of the above claim(s) 18-21, 37-40, 52-67 and 80-82 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 33 is/are allowed.
- 6) ☒ Claim(s) 1-9, 11-17, 22-31, 34-36, 41-44, 46-51 and 68-79 is/are rejected.
- 7) ☒ Claim(s) 10, 32 and 45 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 12/22/03.
- 4) ☐ Interview Summary (PTO-413),
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

This action is in response to the Remarks filed on 6/28/04.

Election/Restrictions

1. Applicant's election without traverse of Group I, claims 1-17, 22-36, 41-51, and 68-79 in the response filed on 6/12/03 is acknowledged. Accordingly, claims 18-21, 37-40, 52-67, and 80-82 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-9, 11-14, 22-28, 30, 68-75, and 77-79 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,320,209 to Hata et al.

As the claims are directed to a light emitting device, per se, the method limitations appearing in claims 4-7, 25-28, 51, 77, and claim 41, line 4; claim 68, line 4; claim 76, lines 2-3; and claim 78, line 4 have only been accorded weight to the extent that it affect the structure of the completed light emitting device. Note that "determination of patentability in 'product-by-process' claims is based on product itself, even though such claims are limited and defined by process [i.e., "selective growth"], and thus product in such claim is unpatentable if it is the same as, or obvious form, product of prior art, even if prior product was made by a different process", *In re Thorpe, et al.*, 227 USPQ 964 (CAFC 1985). Furthermore, note that a "product-by-process claim, although reciting subject matter of claim in terms of how it is made [i.e., "selective growth"] is still product claim; it is patentability of product claimed and not recited process steps that must be established, in spite of fact that claim may recite only process limitations", *In re Hirao and Sato*, 190 USPQ 685 (CCPA 1976). For the purpose of examination, "selective growth"-based steps have only been accorded weight to the extent that the device has the proper physical structures to make selective growth possible.

Regarding claims 1, 8, 9, 22, 68, and 70, Hata discloses a light emitting device comprising: a substrate (101) with a surface along the C-plane (column 4, lines 34-40); a crystal layer (105-109) with a crystal surface oriented along an S-plane (column 6, lines 65-67; figure 6c); first and second conductive layers (109, 111 or 106), and an active layer (107), all formed along a portion of the crystal surface. Hata further discloses a layer of a first conductivity type (106) and a layer of a second conductivity type (109) formed along the hexagonal pyramid. Hata even further discloses that an area of the active layer is larger than an area of the window region

Art Unit: 2813

(figures 6A-6C), and that the area of the active layer is larger than the sum of the projection of the active layer and the area through which an electrode (112) adjoins a contact layer (see figure 6c).

Regarding claims 2, 3, 13, 23, 24, 69, and 73-75, Hata discloses that the crystal layer is a nitride semiconductor material, GaN/InGaN, which has a wurtzite crystal structure and is a “substantially symmetrical hexagonal structure” (column 5, lines 25-50; a wurtzite lattice is a symmetrical hexagonal arrangement of atoms).

Regarding claims 4-7, 25-28, 71, and 77, Hata discloses a selective growth arrangement (figure 6c), with a material layer capable of growth (103) interposed between the substrate and the grown layer (figure 6c), with a masking layer (104) having openings through which the crystal layer grows (figures 6A-6C), and where the crystal layer extends laterally from the opening in the masking layer (figures 6B-6C).

Regarding claims 11 and 30, Hata discloses that a current flows through the active region (column 5, lines 60-67).

Regarding claim 12, Hata discloses that the active layer is InGaN (column 5, lines 37-50).

Regarding claim 72, Hata discloses electrodes (112, 111) connected to the conductive layers for injecting current into the active region (column 5, lines 63-67).

Regarding claims 14 and 78, Hata discloses a device comprising: a substrate oriented along a c-plane (column 4, lines 34-40); an active layer (107) disposed between first and second conductive layers (109, 106), where a portion of the active layer (center portion, between the two

Art Unit: 2813

pyramids; see figure 7c, figure 6c) is directed away from the active layer plane towards the substrate.

4. Claims 1-9, 12-14, 22-29, 68-71, 73-75, 77, and 78 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,981,977 to Furukawa et al (cited by applicant).

Regarding claims 1, 8, 9, 22, 29, 68, and 70, Furukawa discloses a light emitting device comprising: a substrate (101) with a surface along the C-plane/ C+ plane (column 8, lines 6-11; principal plane of sapphire is a c+ plane); a crystal layer (112) with a crystal surface oriented along an S-plane (figure 4d); first and second conductive layers of first and second conductivity types (112 and 116), and an active layer therebetween (114), all formed along a portion of the crystal surface (figure 4d). Furukawa even further discloses that an area of the active layer is larger than an area of the window region (figures 4d).

Regarding claims 2, 3, 12, 13, 23, 24, 69, and 73-75, Furukawa discloses that the crystal layer is a nitride semiconductor material, InGaN, which has a wurtzite crystal structure and is a “substantially symmetrical hexagonal structure” (column 9, lines 1-5).

Regarding claims 4-7, 25-28, 71, and 77, Furukawa discloses a selective growth arrangement (figures 4 and 5), with a material layer capable of growth (103) interposed between the substrate and the grown layer (figures 4a-4d), with a masking layer (111) having openings (111A) through which the crystal layer grows (figures 4 and 5), and where the crystal layer extends laterally from the opening in the masking layer (figures 4 and 5).

Regarding claims 14 and 78, Furukawa discloses a device comprising: a substrate oriented along a c-plane (column 8, lines 6-11); an active layer (114) disposed between first and

Art Unit: 2813

second conductive layers (112, 116), where a portion of the active layer (center portion, between the two pyramids; see figure 4d) is directed away from the active layer plane towards the substrate.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 41-44 and 46-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Furukawa et al. in view of U.S. Patent No. 5,814,839 to Hosoba.

Regarding claims 41, 43, 44, and 46, Furukawa discloses a light emitting device comprising: a substrate (101) with a surface along the C-plane (column 8, lines 6-11); a crystal layer (112) oriented along an S-plane (figure 4d); first and second conductive layers of first and second conductivity types (112 and 116), and an active layer therebetween (114), all formed along a portion of the crystal surface (figure 4d).

Furukawa fails to teach a reflecting region formed parallel to the crystal surface and having at least two planes that intersect with an angle less than 180 degrees.

Hosoba discloses a light emitting device having a reflecting region (109, 120) that corresponds to the shape of an active region (3,33; see figs 8 and 17), and thus has at least two planes meeting at an angle of less than 80 degrees.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to include in the light emitting device of Furukawa the reflecting layer taught by Hosoba. The rationale is as follows: A person having ordinary skill in the art would have been motivated to provide a reflecting layer below the active region, because Hosoba shows that doing so improves the light extraction efficiency of the LED (Hosoba, column 27, lines 20-30).

Regarding claims 42, and 47-49, Furukawa discloses that the crystal layer is a nitride semiconductor material, InGaN, which has a wurtzite crystal structure (column 9, lines 1-5).

Regarding claim 50, Furukawa discloses that the active layer is entirely contained within a single device, and thus must be separated for each device (figures 4-6).

Regarding claim 51, Furukawa discloses a selective growth arrangement (figures 4 and 5), with a material layer capable of growth (103) interposed between the substrate and the grown layer (figures 4a-4d), with a masking layer (111) having openings (111A) through which the crystal layer grows (figures 4 and 5), and where the crystal layer extends laterally from the opening in the masking layer (figures 4 and 5).

7. Claims 15-17, 34-36, and 76 are rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. in view of U.S. Patent No. 5,732,098 to Nisitani et al.

Regarding the claims, Furukawa discloses a light emitting device comprising: a substrate (101) with a surface along the C-plane (column 8, lines 6-11); a crystal layer (112) with a crystal surface oriented along an S-plane (figure 4d); first and second conductive layers of first and second conductivity types (112 and 116), and an active layer therebetween (114), all formed along a portion of the crystal surface (figure 4d). Furukawa further discloses that the active

Art Unit: 2813

layer is entirely contained within a single device, and thus must be separated from any adjacent devices (figures 4-6).

Furukawa fails to specify that the light emitting device is part of a display with plural light emitting devices.

Nisitani discloses an array with a plurality of light emitting diode devices (figures 14). All of the light emitting devices are wired in an array, and thus are responsive to an identical signal (figures 14 and 15).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to specify that the light emitting device of Furukawa is part of an array of plural devices, as suggested by Nisitani. The rationale is as follows: A person having ordinary skill in the art would have been motivated to provide a plurality of devices, so that the light emitting devices could be arranged in a matrix in order to provide an image display (Nisitani, column 14, lines 20-37).

8. Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al. in view of the Applied Physics Letters v(76) n(22) to Tachibana (cited by applicant).

Furukawa discloses a light emitting device comprising: a substrate (101) with a surface along the C-plane (column 8, lines 6-11); a crystal layer (112) with a crystal surface oriented along an S-plane (figure 4d); first and second conductive layers of first and second conductivity types (112 and 116), and an active layer therebetween (114), where it is possible to form the active region as a hexangular pyramid (column 8, lines 54-62).

Furukawa fails to specifically disclose that the active region in this embodiment is formed in the shape of hexagonal pyramid.

Tachibana discloses that it is advantageous to use an array of hexagonal pyramids as the active layer of a nitride-based light emitting device (figure 1a-1c).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the active layer of Furukawa, such that it includes the hexagonal pyramids taught by Tachibana. The rationale is as follows: A person having ordinary skill in the art would have been motivated to use hexagonal pyramids, because Tachibana shows that such structures have lower threshold currents than typical quantum well lasers (see Tachibana, page 1, column 1).

Allowable Subject Matter

9. Claim 33 is allowed.

10. Claims 10, 32, and 45 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

11. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claims 10 and 45, although the prior art, such as U.S. Patent No. 6,252,255 to Ueta et al. suggests that it is advantageous to have some degree of inclination of a crystal face upon which growth is to be performed, Ueta tends to teach that inclinations above about 1 degree lead to surface roughness and bad crystal growth. Regarding claim 33, the prior art does not

Art Unit: 2813

suggest forming an active layer in the shape of a hexagonal prismoid, but rather only teaches full hexagonal pyramid-shapes or S- faced ridge shapes. It is the examiner's opinion that since it is generally difficult to grow nitride or any hexagonal-lattice light emitting crystal structures with good growth quality and a low defect density, any significant changes to the growth procedure or the expected resultant shape would not have been obvious to one skilled in the art.

Regarding claim 33, there is no suggestion in the prior art of having a hexagonal pyramid shaped active layer with a decreased current density near the apex. Since in order to achieve this reduced current density, a portion of the electrode overlying the apex must be removed from the structure, and since the prior art only teaches structures in which the top electrode completely covers the slant or central portions of the active layer, it is the examiner's opinion that such a modification would not have been obvious.

Response to Arguments

12. Applicant's arguments filed 6/28/04 have been fully considered but they are not persuasive.

13. In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., burying the active layer or using a stripe-shaped opening for selective growth) are not recited in the rejected claims. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

The applicant argues that Furukawa discloses a buried active layer, that the active layer is flattened into a planar surface, as shown in figures 6A and 6B, and that the selective growth opening is a stripe. This is not persuasive, because the applicant does not claim that the active layer is not buried. Furthermore, Furukawa clearly shows in figures 4C and 4D that the active layer can be angled with respect to the substrate surface plane, and in fact could be a hexangular pyramid in shape (see column 8, lines 58-65). Although it is noted *supra* that the claims do not specify the shape of the selective growth mask, but rather only require that a growth mask with an opening is used to attain a crystal face slanted relative to the substrate plane, Furukawa does, in fact, suggest the usage of selective growth mask openings other than a stripe, such as circular openings (see column 7, lines 20-27; column 8, lines 54-62).

The applicant further argues that neither Hata nor Furukawa disclose a symmetrical hexagonal structure or a hexagonal pyramid. This argument is not persuasive, because for the vast majority of the claims, such a feature is not present in the claims. The applicant does not provide any arguments about the specific validity of the independent claims, such as claim 1, and what specific claimed features are perceived to be missing in Hata. In response to the arguments pertaining to claims 13 and 31, it is the examiner's opinion that any wurtzite structure would be considered to be a symmetrical hexagonal structure, since the applicant does not provide any specific details in the claims as to what is encompassed by the term 'symmetrical hexagonal structure,' and since a wurtzite lattice is by definition a symmetrical hexagonal lattice. Even if the applicant disagrees with this line of argument, it is respectfully pointed out that Furukawa does, in fact, disclose a hexagonal pyramidal structure for the active region (see Furukawa, column 8, lines 54-62), and likewise, the American Institute of Physics article to Tachibana, used

Art Unit: 2813

in the rejection of claim 31, *supra*, clearly teaches the usage of hexagonal pyramidal structures in optical devices.

Regarding the rejections using Furukawa combined with Hosaba, Nisitani, and Tachibana, the applicant does not comment on the validity of the combination as set forth in the prior office action, but rather only comments on the teachings of Furukawa. Specifically, the applicant provides no arguments on the obviousness of providing a reflecting region based on the teachings of Hosaba, a plurality of the light emitting devices, based on the teachings of Nisitani, or a hexagonal pyramidal structure, based on the teachings of Tachibana.

Conclusion

14. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Art Unit: 2813

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Dolan whose telephone number is (571) 272-1690.

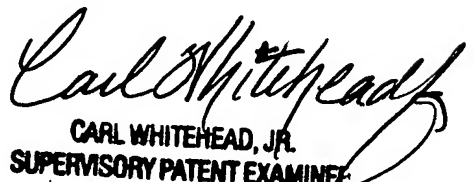
The examiner can normally be reached on Monday-Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead, Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jennifer M. Dolan
Examiner
Art Unit 2813

jmd


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800